

**Dr. Gresswell's Report to the Local Government Board on
the Sanitary Condition of Cradley in the Rural Sanitary
District of Stourbridge, and on the recent Prevalence of
Enteric Fever there.**

R. THORNE THORNE,
Assistant Medical Officer,
August 15th, 1889.

Cradley,—a parish under the jurisdiction of the Stourbridge Rural Sanitary Authority,—like many neighbouring places in the coal and iron districts of Worcestershire and Staffordshire, has long been known to the Board for grave sanitary shortcomings and for prevalence of filth diseases. And a severe outbreak of enteric fever having occurred in Cradley in the latter part of 1888 and the early part of 1889, an inspection of the district was ordered with a view of learning the circumstances which had attended this disease-prevalence, and the nature and extent of the improvements effected by the Sanitary Authority in regard of the recommendations of the Board, addressed to the Authority after three several inspections, the first by Dr. Ballard in 1873, the second by Dr. Parsons in 1880, and the third by myself in 1886.

Cradley parish, in North Worcestershire, occupies 732 acres within a semi-circular bend of the River Stour. It is separated by the latter from Hawn, Cradley Heath, and Quarry Bank, while to the west and south it adjoins Lye, Wollescote, Lutley, and Hasbury.

The portion of the river which bounds Cradley flows north-eastwards, then north-westwards, and finally south-westwards; and in its course falls from a level of 330 feet to one of 250 feet above Ordnance datum. Cradley lies at an average elevation of some 400 feet above the same datum.

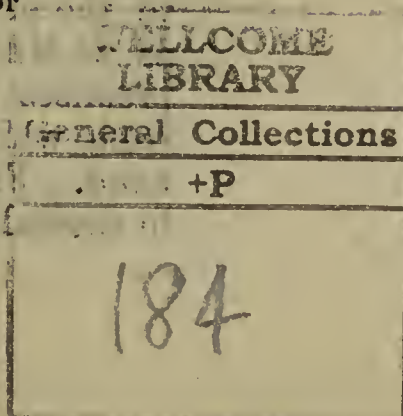
The inhabitants of Cradley, 5,284 in number at the census of 1881, occupy for the most part the summit and slopes of a straggling ridge, which, speaking generally, takes the same direction as the river, and which, from an elevation of about 500 feet above Ordnance datum at Parkside in the south, descends in a course of 2 miles or so to a level of about 300 feet at Lane's End in the north-west. The main line of dwellings is, however, not continuous; broadly speaking, there are two groups of population, of which the northern is much the larger. The dwellings of the southern group are situated for the most part on or towards the summit of the ridge, those of the northern are situated chiefly on the sharp slope from the ridge to the river, where they form a small compact town reaching from near the summit of the ridge down to the river's edge, with one main street (the High Street, continued on as Lyde Green) and smaller streets and lanes at right angles thereto, together with some courts. Hereafter it will be convenient to speak of the northern group of dwellings as Cradley proper. The lower part of this group, perhaps a third of it, is built upon clay of varying thickness; most of the dwellings of the rest of the district stand upon sandstone or on the rubble and sand, into

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

And to be purchased, either directly or through any Bookseller, from
EYRE AND SPOTTISWOODE, EAST HARDING STREET, FLEET STREET, E.C.; or
ADAM AND CHARLES BLACK, 6, NORTH BRIDGE, EDINBURGH; or
HODGES, FIGGIS, & Co., 104, GRAFTON STREET, DUBLIN.

1889.

Price Threepence.



which it has been converted towards the surface; while beneath the whole of the district are the Coal Measures. Here it is to be remarked that mining operations have brought about subsidences in various parts of the district, so that not a few buildings, including the church, have been much damaged.

The rateable value of Cradley parish is 16,550*l.*, but more than half of this sum is derived from other than house-property, chiefly from coal- and fireclay-mines and fire-brick works. House property, for the most part freehold and in the hands of some 250 owners, has a rateable value of only 7,479*l.*, as many as 612 out of the total of 1,102 houses being rated at values of or below 5*l.*, and only 155 at values of or above 10*l.* It is believed that much of the house property is mortgaged.

The inhabitants are engaged in mining, and, females as well as males, in chain-making in small forge-shops near to the cottages. They have increased in numbers very steadily for many years past, the successive census returns commencing with 1831 having been as follows, viz., 2,202, 2,686, 3,383, 4,075, 4,700, and 5,284.

Passing now to the general sanitary condition of Cradley, and contrasting it with that observed by Dr. Parsons in 1880, it is to be noted that the improvements effected by the Authority are neither numerous nor extensive.

The Highway Authorities have laid down during the last 10 years some 3 miles of 9" and 12" socketed pipes, for drainage of all the chief roadways not previously drained. Old brick-and-mortar culverts, about 2 feet in diameter, still, however, remain in use in Cradley proper (in the High Street, Butcher's Lane, and New Street). The socketed pipes are not cemented at the joints, and neither they nor the culverts have their inlets trapped. Road gullies are not provided with catchpits. For about a half of the dwellings, there are channels by which liquid refuse may find its way to these conduits, but most of the channels are circuitous,—mere tracks upon the surface, cut by the sewage in the loose soil, or bricked gutters many or most of them only dry-steyned); a few are covered, and these are commonly faulty as to the mode of their construction, trapping, and ventilation.

At one house, where typhoid fever occurred, there is a trapped indoor sink-inlet. A pipe-drain, consisting of socketed and cemented pieces, extends from this sink through adjoining premises to the old culvert in the High Street, and in its course through these premises, a trapped outdoor sink and the soil pipe of a water-closet discharge into it. There is no ventilation for any part of this drainage system. When the water-closet handle is raised, the indoor sink trap is, it seems, sucked dry, and a "sickening" stench pervades the house. At another place the wash-water from the house passes by a gutter to the lower end of the garden, some 12 yards from the house, where it forms a swamp, and has to be removed by barrow. At another place an unventilated pipe-drain has been laid from the lower part of the wall (not from the floor) of a cellar to one of the old culverts.

Half or so of the house sewage, as well as filth from a few water-closets and slaughter-houses, passes into the highway drains, which ultimately discharge directly or indirectly into the river. These drains frequently become silted up in wet weather, owing, it is said, to the large amount of road detritus washed into them. This is formed in abundance from the slag of the iron-furnaces which is used as metal for the roads, and it is carried off into the drains, there being, as already said, no provision at the gully inlets for intercepting solid matters of this sort. Four of the main highway drains were blocked in this way quite recently, three of them at the time of this inspection. House-drains also are frequently blocked owing to a similar cause, and then, as in instances which came under my notice, a sewage swamp ensues and extends over several contiguous premises. It should be stated also that there is no public paving in the district; in the chief places there are kerbing and irregular channelling, but the footpaths are uneven, and, consisting, as they do, largely of ashes and slag, they add their quota to the sediment which tends to block the drains.

In cases in which liquid refuse from the house is not disposed of by way of the drains—and this holds of perhaps a half of the total—it is thrown on to the premises to soak, if it can, into the ground, or else to form swamps, as at Mill Street and Hightown. In many cases it passes into holes on the premises or into unventilated cesspools, which require no emptying, and from which it leaks away for years together, perhaps into cellars near at hand. From a particular group of houses it passes into a disused well; and in several cases it is disposed of in the midden.



Scavenging has, in obedience to an Order of the Local Government Board, under section 42 of the Public Health Act, 1875, dated January 25th, 1886, been carried out by the Authority under contract, the contract having been let for the current year at 65*l.* Last year it was let at 75*l.*, and in the previous year at 85*l.* The journal of the Inspector of Nuisances shows that 2,039 cartloads of refuse and excrement were removed from 1,292 premises in the year ending April 30th, 1887, and 1,834 loads from 1,533 premises in the year ending April 30th, 1889. Seeing then that the inhabited dwellings in 1881 numbered 988, it will be evident that scavenging of any one set of premises has not taken place on an average more frequently than once in six months. And as the premises are not taken in any regular order, not a few of them are overlooked from one year's end to the other.

The large deep open dilapidated middens remain as heretofore, though, it is to be noted that 42 of them have been roofed over since the fever broke out. The walls of some of these middens have special openings for admission into them of liquid refuse from cottages and piggeries. In wet weather these filth-receptacles tend to overflow and streams of liquid filth run over the premises, it may be beside the mouth of the well and towards the dwelling. Many middens adjoin, or stand immediately under the windows of, the dwelling or the forge-shop; one is beneath the living room of a cottage, being approached from a lower level; and others must needs be emptied through the cottage.

Instances of gross nuisance of similar sort are met with in all parts of the district. At the back of some houses in New Street there are several open and adjoining middens, which together occupy an area of about 4½ square yards; they practically form a single open cess-pool. This filth-depository is not 8 yards from the houses, and only 3 yards above the well, towards which all soakage and overflow necessarily pass; and the water of the well, though used by the inmates of these houses, is "not fit for human being to drink, for it's full of insects, and smells when it's boiled." At Windmill a large part of the small outdoor premises of four cottages is occupied by open middens, piggeries, and swamps of liquid refuse from the cottages and the piggeries; while two wells on the premises afford the sole supply of water to the cottagers. At another place a privy-vault overflows by a pipe into a small open wooden barrel, planted in the centre of a flower-bed, a few yards from the house; the pipe becomes frequently blocked; and the housewife then resorts to a broom-handle in order to force a passage down the pipe; in wet weather the barrel overflows and gives rise to much stench.

It should also be stated that piggeries, and large underground swill-cisterns (their contents often in a state of decomposition) are pretty numerous on house premises.

The water service of the South Staffordshire Waterworks Company, whose mains lie in most of the roadways, furnished supplies, at the time (1880) of the inspection by Dr. Parsons, to 195 dwellings; at the middle of last year to 443; and now, since the outbreak of fever, it furnishes supplies to 563, or rather more than half of the total number in the district. For the other dwellings water is got, as before, from a few wells sunk deeply in sandstone rock, or from a few springs in the fields, the water of which is taken either directly at the spring by dipping, or at a spout to which the water is conducted from the spring in ordinary field pipes. In some instances rain-water from the roof is the only supply. It should be stated that in Cradley proper 100 or more dwellings were supplied up to December of last year with water from the town well; but this well having been proved to be polluted was closed at that time, and tap water has since been largely substituted.

Mention may here be made of some of the local supplies. At Two Gates, where there are about 80 dwellings, 60 of them are supplied with water from some half dozen wells. Most of these have been found by the Medical Officer of Health to be polluted, and as matter of fact, the cottagers get their drinking water either from a particular private pump-well or from the "park spring." They are allowed access to the former only during wet seasons; at other times they must needs go to the spring, a distance, for some of them, of 600 yards there and back. The water of this spring collects to a depth of about half a foot in a small hollow on the slope of a grass field, and is fed from open fissures in the sandstone hill immediately above. Again water issuing from a spout in Spring Lane is resorted to by 12 to 40 cottagers, some of whom have to go half an hour's walk to get it; this spout is fed through ordinary field pipes laid superficially in a field now growing mangolds. A similar spout at Overend furnishes water for about 30 cottagers; it is fed from a spring in a field from which the water finds its way to the spout, first by an open ditch, and then through socketed pipes. At the time of inspection two or three loads of human excrement and manure lay over the course of the lower end of the socketed pipes. In the immediate vicinity of many of the wells there are open middens, piggeries, drains, sewage swamps, dumb wells, and the like.

Dwellings remain for the most part much as they were reported by Dr. Parsons, very dirty, badly ventilated, and quite commonly close and fusty. I am informed, indeed, that in the old dwellings no new window has been

constructed, and no sealed window has been made to open since his visit. Limewashing is a comparatively rare event; even many of the cottages that were invaded by fever, though still tenanted, remain as before, dirty and foul. It is true the inhabitants work in grimy atmospheres, that most of the outdoor premises are covered with coal-ash from the small forge-shops, and that much smoke is belched from the chimneys of this and the surrounding districts; but the dirtiness and offensiveness of the dwellings must in the main be attributed to want of ventilation, insufficiency of cleansing, and frequency of over-crowding.* It may be observed, also, that as the surface of much of the ground slopes sharply, many of the dwellings have been, so to speak, let into the hill-side, and that they are unprovided with any special protection against the dampness, to which they are thus exposed.

Slaughter-houses and dairies are neither properly constructed nor properly managed. As regards the former, there are to be noted loosely bricked floorings, direct communication with the pound, faulty drainage, and other objectionable conditions. One of the dairies is in the undrained beer cellar of a public-house, the walls of which are covered with moist fungus, and the milk-pails in this case are rinsed and left to dry in a small outhouse in which household washing is carried on.

Some of the schools are not well ventilated. Perhaps the worst off in this respect is one of the British schools, at which there is an average attendance of 100 to 120 infants, and the chief room of which is ventilated only by means of six windows, each of about $2\frac{1}{2}$ feet square, and none of them so situated in the walls as to secure proper ventilation for the upper half of the school room. In another of the British schools there is a pit in the floor of the chief room, in which the school sweepings are disposed of, and in which they are allowed to accumulate to an extent, as at the time of inspection, of a good-sized barrow load. At all the schools the old-fashioned middens remain in use, and scavenging of them is conducted only at intervals of about three months.

Under the great variety of unwholesome conditions above enumerated, the persistence of filth disease is almost a matter of course, and its epidemicity is now and again to be looked for. On referring to Table A., which shows the yearly number of deaths registered in Cradley as due to enteric fever and certain other diseases, it will be seen that during the last $12\frac{1}{4}$ years, with a population in 1881 of 5,284, there have been as many as 46 deaths from this fever, distributed in the main in two smart outbreaks, one having occurred in 1877 and 1878, the other being that with which this Report specially deals. No doubt other deaths in the table are also to be regarded as due to enteric fever. Medical men practising in Cradley and the surrounding districts say that enteric fever is rarely absent from this area.

TABLE A.
SHOWING the NUMBERS of DEATHS registered YEARLY in CRADLEY as due to ENTERIC FEVER and certain other DISEASES.

Diseases.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889, up to April 7th.	Totals.
Enteric or typhoid fever -	16	5	3	2	2	2	—	1	—	—	—	8	7	46
“Fever” -	—	1	—	1	—	—	—	—	—	—	—	—	—	2
Enteritis -	—	1	—	1	—	—	—	—	—	—	—	—	—	2
Gastric catarrh -	—	—	—	—	—	—	—	1	1	—	—	1	—	3
Cerebritis -	—	2	—	—	—	—	—	—	1	1	1	1	—	6
Meningitis -	1	—	—	—	1	1	—	1	1	1	1	—	—	7
Tubercular meningitis -	—	1	—	1	1	1	—	2	—	—	1	—	—	7
Cerebro-spinal meningitis -	—	—	—	—	—	1	—	—	—	—	—	—	—	1
Acute peritonitis -	—	—	—	—	—	—	—	—	—	—	—	1	—	1
Tabes mesenterica -	—	3	—	—	—	—	—	1	2	2	2	—	—	10
Diarrhœa -	—	1	1	2	2	3	1	3	2	5	2	8	—	30

* In a particular cottage four persons sleep on one bed in a room which has a cubic capacity of only 320 feet. There is no flue in this room, and there is but one window, which has an area of about $2\frac{1}{2}$ square feet, and this opens directly over an old-fashioned open midden.

It will also be observed that the numbers of yearly deaths from infantile diarrhoea in Cradley (all but two of the deaths from diarrhoea recorded in the table having occurred at ages under five years) have been on some occasions excessive.

In Lye and Wollescote parishes, with a total population in 1881 of 9,382, adjoining Cradley; and like it forming parts of the Rural Sanitary District of Stourbridge, the following with other deaths were registered for the period from the beginning of 1879 to the end of 1888, viz., 67 from typhoid or enteric fever, 16 from febricula, 1 from continued fever, 2 from typhoid pneumonia, 1 from acute gastritis, 6 from enteritis with or without peritonitis, 1 from typhilitis, 9 from meningitis (simple or tubercular), 1 from meningo-encephalitis, 7 from cerebro-spinal meningitis or cerebro-spinal fever, 4 from cerebritis, 4 from tubercular peritonitis, 6 from acute peritonitis, 2 from infantile remittent fever, 1 from vermicular fever, 1 from dysentery, and 81 from diarrhoea.

At Pensnett, Bromley, Brockmoor, and Wordsley, also in the Rural Sanitary District of Stourbridge, there were 16 deaths from enteric fever in the year 1888, a matter which formed the subject of some notes to the Board by Dr. Parsons in November of that year.

It may be remarked also that in five parishes near to Cradley, viz., Hill, Halesowen, Lapal, Hasbury, and Hawn, with a total population in 1881 of 8,630, there were among persons under 5 years of age 25 deaths attributed to diarrhoea, gastric, gastro-enteric, and enteric catarrh in the period from May 27, 1888, to May 9, 1889.

Quite possibly the circumstance that the children of Cradley and of the surrounding districts are so commonly infested with "round worms"—the fact as to which is attested by each of the medical practitioners with whom I was brought into communication—is, in a measure, the result of the foul condition of outdoor premises. The filth heaps and the sewage swamps, on and about which the children spend much of their playtime, must contain exceptional numbers of the ova of this parasite, which in dry weather could be carried by almost every gust of wind into the dwellings, and so get abundant opportunity of lodgment in food.

The Enteric Fever Outbreak.

Special attention has now to be given to the recent outbreak of enteric fever in Cradley. For a knowledge of the cases I am indebted to the medical men of the district, who were good enough to give me full information concerning the persons whom they had attended. It is perhaps needless to say that there must have been persons in many households, who, though in all probability suffering from typhoid fever, received no medical advice. Taking cognizance of all cases that came to my knowledge as having occurred between the date of inspection (June 10th, 1889), to as far back as December 11th, 1887, prior to which for three years there had been no death from this disease in Cradley itself, it appears that 52 dwellings were invaded; out of the 316 inmates of these dwellings, 113, or 35·7 per cent., manifested symptoms of the disease, and 16 of the latter, or 14·1 per cent., died.

The incidence of the disease on several age-groups is shown thus:—

Of the inmates of the 52 invaded dwellings—

38	were under 5 years of age; of these	4	were affected, i.e., 10·5%, and none died, i.e., 0·0%.
46	„ 5 to 10 „	22	„ 47·8%, and 2 „ 9·0%.
47	„ 10 to 15 „	27	„ 57·4%, and 4 „ 14·8%.
38	„ 15 to 20 „	18	„ 47·3%, and 1 „ 5·5%.
147	„ over 20 „	42	„ 28·5%, and 9 „ 21·4% } 15·8%.

The gravity of the disease in relation to age of the patient was that usually observed in epidemics of enteric fever. And similarly, the customary prevalence of the disease in relation to season was duly observed, the number of households invaded in different months having been as follows:—

1887.—December, one.

1888.—February, one; March, one; May, one; July, one; August, two; September, three; October, three; November, sixteen; December, eight.

1889.—January, nine; February, three; April, three; May, none.

As regards localization of the disease, the following facts are worthy of notice. In Cradley proper 47 dwellings were invaded; 104 of their 283 inmates were affected, and 12 died. In the rest of the district 5 dwellings were invaded; 9 of their 33 inmates were affected, and 3 died. Again in the outbreak in 1877 and 1878 the deaths in Cradley proper numbered 14; and those in the rest of the district 7. Hence in the recent outbreak the proportion of deaths in Cradley proper to the total of enteric fever deaths in the parish was 80·0%; and in the earlier outbreak it was

65:6%, proportions which fairly coincide with those in which the population is distributed in these respective areas.

The question now arises as to the cause of the exceptional prevalence and fatality from enteric fever last year. The fact that the distribution of the deaths in this epidemic, like that in the epidemic of 1877 and 1878, so nearly coincided with the distribution of the population, would suggest similarity of the conditions under which the disease was fostered on the two occasions. Also the facts are consistent with presence of a well-nigh ubiquitous fever-virus, which was but awaiting the necessary conditions, seasonal and other, for manifesting itself by epidemic spread of disease. And in this connexion it deserves notice that in both epidemics at Cradley enteric fever exhibited its commonplace seasonal behaviour. But season, though operating in its own way (at one time inhibiting, at another fostering potency of the virus) must be regarded as powerless to bring about an epidemic without assistance from other conditions favouring multiplication of the virus, and securing wholesale dissemination of the multiplied material among persons susceptible to the particular disease.

As matter of fact, of the various conditions requisite for enteric fever prevalence the chief of them were operative at Cradley, viz., fever-virus aforetime distributed about the district, and as well peculiar facilities for multiplication and dissemination of such virus when the time for its seasonal activity had arrived. Among many means in Cradley for dissemination of virus of the above sort a particular local water supply deserves especial notice.

It appears that on December 6th, 1888, the Medical Officer of Health, finding that there had been a remarkable incidence of the disease upon persons using the water of the town-well, sent a sample of this water for analysis to Dr. Swete, the county analyst. Dr. Swete reported the sample to be "largely polluted with organic matter"; and the well was accordingly closed on December 10th. By this time 33 households had been invaded. Of these 22 had been using this well water daily; five others had become invaded through school-children, who it is said in all probability drank of the same water while on their way to or from school; while two other primary cases were referable to secondary infection; so that invasion in 29 cases out of the 33 may be regarded as having been due possibly to this water.

Further, if an incubative period of two or more weeks be allowed, cognizance must be taken also of four other households invaded within such period after the closing of the well. For one of these the water had been always taken from the well; two others were invaded in the persons of school children, who are said to have drunk water from the well; and one was clearly a secondary case.

Hence of the 37 households invaded by the end of the year, 33 may be regarded as having possibly got their infection through this particular water.

Of households later invaded there were 15. Four of these may easily have derived their infection from prior cases, with which they had been in relation; leaving eleven primary attacks to be otherwise accounted for. In this connexion it is of importance that only one of the eleven occurred in a locality which had not been affected with fever in recent months, and that in this case the person who introduced fever into his family was employed in an adjoining district, where also the fever was prevailing at the time. In the second place it is of importance to bear in mind the circumstances obtaining in the district by the time the well was closed.

Specific stools had now been deposited in almost all parts of the fever-district in middens, most of which were used by more than one family, and in particular instances, by as many as half-a-dozen or more. Liquid refuse from invaded cottages was now flowing above the surface in a variety of places, even by the very doorways of the cottages. Ill-constructed drains, public and private, having received specific typhoid matters, were giving egress to their emanations at many an inlet. Water supplies, almost of necessity specifically polluted, were in common use. Children (through whom 8 of the 11 households were invaded) were at play in the sewage gutters and about the filth heaps on the premises. Poultry, at one moment investigating the filth out of doors, were at another mingling with the family in the

cottage. School children (through whom 7 of the 11 households were invaded) had to pass daily on their way to school along a very narrow lane (Banklays) bordered on one side by a row of five dwellings (mere hovels) each of which, save perhaps one, had already contained one or more typhoid patients, and which were (and indeed remain now) unprovided with proper drains or with proper filth receptacles; and school children had to make use of the filthy old-fashioned middens provided by the school authorities and into which typhoid stools had certainly been passed. Persons from invaded households were now distributed day by day in various parts of the district, at school, in the mines, and in the forge-shops. Moreover, dairies, cowsheds, and slaughter-houses remained altogether unregulated, and it is known that in one case a member of an infected family for some two weeks or so spent the night at her home and the day among the milk pails at a dairy. And not least, there is the fact that the measures adopted by the Authority in dealing with the fever-prevalence did not include any definite attempt at isolation of the sufferers, or any real improvement in the filth-receptacles or of the drainage, not even compulsory cleansing of dwellings, wherein whole families had suffered from the disease.

If regard be had to these various circumstances, it will be evident that facilities for acquiring infection after the well was closed were as abundant as they were diverse; and that therefore the precise influence, in spreading the fever, of one or another of them can be but matter for surmise.

Attention has now to be given to the construction of the particular well, and to the likelihood of its having received typhoid matters.

The well is an old heading, 16 feet long, 12 feet deep, and 9 feet broad, driven horizontally into the solid sandstone almost completely across and beneath the High Street, the internal surface of the crown of the heading being about $3\frac{1}{2}$ feet from the surface of the street. The mouth of the heading is bricked up, and the water flows into and accumulates in the reservoir or well thus formed, from fissures in the wall at the further end. An old brick-and-mortar culvert in the street, laid at a depth of about 18 inches from the surface, commences only a little higher up the street, 4 yards above the well, passes by the further end of the well at a distance of 2 feet from it, and thence down the street to discharge into the river. Twenty yards or so from the further end of the heading, and on ground which rises therefrom somewhat steeply, there are the church-yard with the church in its centre, and the row of dwellings called Banklays, drainage from the latter passing into the upper end of the culvert in question. The water of the well is derived from the sandstone of this hill, in the superficial layers of which are the graves of the cemetery, uncovered middens, slopholes, and leaking drains. And the tracks, by which water passes to the well, may have been considerably disturbed last year; for the church and other buildings on the hill were at that time damaged by subsidences resulting from mining operations.

It is supposed that pollution of the water of the town well may thus have been brought about. But it should also be stated that certain alterations in the physical circumstances of the well, purposely undertaken last autumn, may also have had concern in it. Water used to be drawn from the well by pumps at the outer end of the heading, but in September 1888 the pumps were placed at the other end, holes being driven with pickaxe and chisel through the roof of that end of the well for the passage of the pump pipes; and it has been thought that the 2 feet of rock separating the culvert from the well may then have been cracked so as to allow leakage from the former into the latter.

And it is quite possible that the water may have received *specific* pollution from the culvert. In February 1887, the occupants of one of the five dwellings in Banklays, liquid refuse from which would pass down the Banklays drain, and so into the culvert, suffered from typhoid fever, contracted, I am told, while nursing some relatives ill of that disease in an adjoining district. And it further appears that this family continued to suffer on and off from enteric fever for many months; and that, so recently as November of last year, two members of this household were attacked by unquestionable enteric fever.

It especially deserves notice that this very water supply was emphatically pointed out to the Authority by Dr. Ballard in 1873 as a source of grave danger; that the epidemic of typhoid fever in 1877 and 1878 was ascribed by Dr. Thompson, then Medical Officer of Health, and by several other practitioners to pollution of this same water; that Dr. Parsons spoke in no hesitating terms of the danger to which Dr. Ballard had previously called the attention of the Authority; and that the vicar in the pulpit and elsewhere stated that the persons who drank of this water "were drinking dead men's bones." Nevertheless the water continued in use.

June 27, 1889.

D. ASTLEY GRESSWELL.
